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A preliminary investigation of the distribution,  
range and extent of reef habitats and  
communities in Port Davey, March 1998.

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## Introduction

Proposals for marine reserves require a clear understanding of the habitats, marine communities and species to be protected within a reserve, and the degree to which these will be represented in any final reserve proposal. In most cases, dive based surveys are necessary during the process of boundary delineation, particularly where information, such as the depth range, degree of exposure and offshore extension of reefs, is limited. The present report describes the results of a diving survey in Port Davey, southwestern Tasmania, which investigated the distribution of different reef habitat types.

At Port Davey, a large marine reserve has been proposed to protect both a "unique" ecosystem, and a "representative" ecosystem. The "unique" ecosystem is a consequence of the dark tannin-stained surface water found in Bathurst Harbour, Bathurst Channel, and Port Davey, whose origins lie in the southwestern rivers, including the Old River and the Davey River. In the calm waters of Bathurst Harbour and Bathurst Channel, this dark stained surface water limits light penetration, allowing plant communities to be replaced by invertebrate assemblages in shallow waters, a process not known to occur on the same scale elsewhere around Australia. As this dark water enters Port Davey from Bathurst Harbour it is dispersed by ocean currents and vertical wave-induced mixing. However, Breaksea Is and the coast adjacent to the mouth of Bathurst Channel are greatly influenced by the tannin waters, so should be considered an exposed coast extension of this unique system.

The "representative" ecosystem that is proposed to be protected in Port Davey is intended to include representative examples of habitats (particularly reef) found in the Davey Bioregion (see Edgar *et al.* 1997) of Tasmanian waters, a region influenced by the West Wind Drift, and high energy swells. The habitats potentially protected in this proposal include sheltered embayments such as Hannant Inlet and Kelly Basin, ranging through to the maximally exposed reef found in outer Port Davey.

While many of the "unique" tannin influenced habitats have been studied during previous surveys (e.g. Edgar 1984a, Last and Edgar 1994), little is known of the distribution of "representative" habitats within Port Davey itself, and the boundaries between representative coastline and that strongly influenced by tannin waters emanating from Bathurst Channel and the Davey River.

The aim of this survey was to aid in the delineation of appropriate reserve boundaries, by examining the distribution, range, and extent of reef habitats within Port Davey. This was to be achieved by conducting qualitative and quantitative surveys of reef communities at as many locations as possible in Port Davey over a seven day period.

## Methods

### *Qualitative surveys of reef habitats and communities.*

Qualitative surveys of reef communities were conducted along the Port Davey coast at sites  $\approx 2$  km apart where wind and swell conditions allowed diver access, between 16-22 March 1988 (see Fig. 1 for sites surveyed). At each location, divers recorded the depth distribution of the dominant algal species, and the relative abundance and depth distribution of fishes and large invertebrates (abalone, crayfish, sea urchins, etc). In addition, the diver recorded the maximum depth of the reef and the extent of offshore reef development, as well as the structural complexity of the reef, and the relative abundance of shelter (caves, crevices). Reef position was recorded by GPS. Detailed qualitative results are provided as Appendix 1.

### *Quantitative surveys of reef communities.*

The quantitative survey methods are outlined in detail in Edgar and Barrett (1997). Essentially they involved three different transect techniques. At each site a 200 m transect was laid along the 5 m depth contour. Fish were counted and their lengths estimated along this line, in 4, 50 m x 10 m transects, where a diver swam in the centre of a 5 m lane on one side of the transect line for 50 m (counting all fish in the lane) then turned and swam back along the other side of the line. Invertebrates and cryptic fish were counted by a diver carefully searching all reef within 1 m of one side of the line for 50 m, and repeating this for 200 m (ie 4x50 m transects). The size of lobsters and abalone were measured to the nearest mm. For macroalgae and sessile invertebrates, a 0.5 x 0.5 m quadrat was placed on the transect line at 10 m intervals and the % cover of each species recorded. Six locations were surveyed by this method: Knapp Point (west of Spain Bay), Milner Head (south side), Milner Head (north side), Kathleen Is (eastern shore), Ashley Pt, Whalers Pt. The detailed quantitative results have been added to the DPIF marine reserve site monitoring database, summary results are presented in this report. A number of other sites had previously been surveyed using the same method in this region by the authors, and their details are included in this report. These sites are: Muttonbird Is, Big Caroline Rock (surveyed at 10 m), and Breaksea Is (eastern shore), Sarah Island and Rough Bay. See Fig. 2 for site locations.

### *Analysis.*

The degree of similarity between quantitative survey sites was examined using the Bray-Curtis similarity index on  $\log(x+1)$  transformed algal % cover data. Information from fish and invertebrate censuses was not used due to the low species diversity recorded at each site using these methods. The results of the analysis are graphically presented using multi-dimensional scaling (MDS).

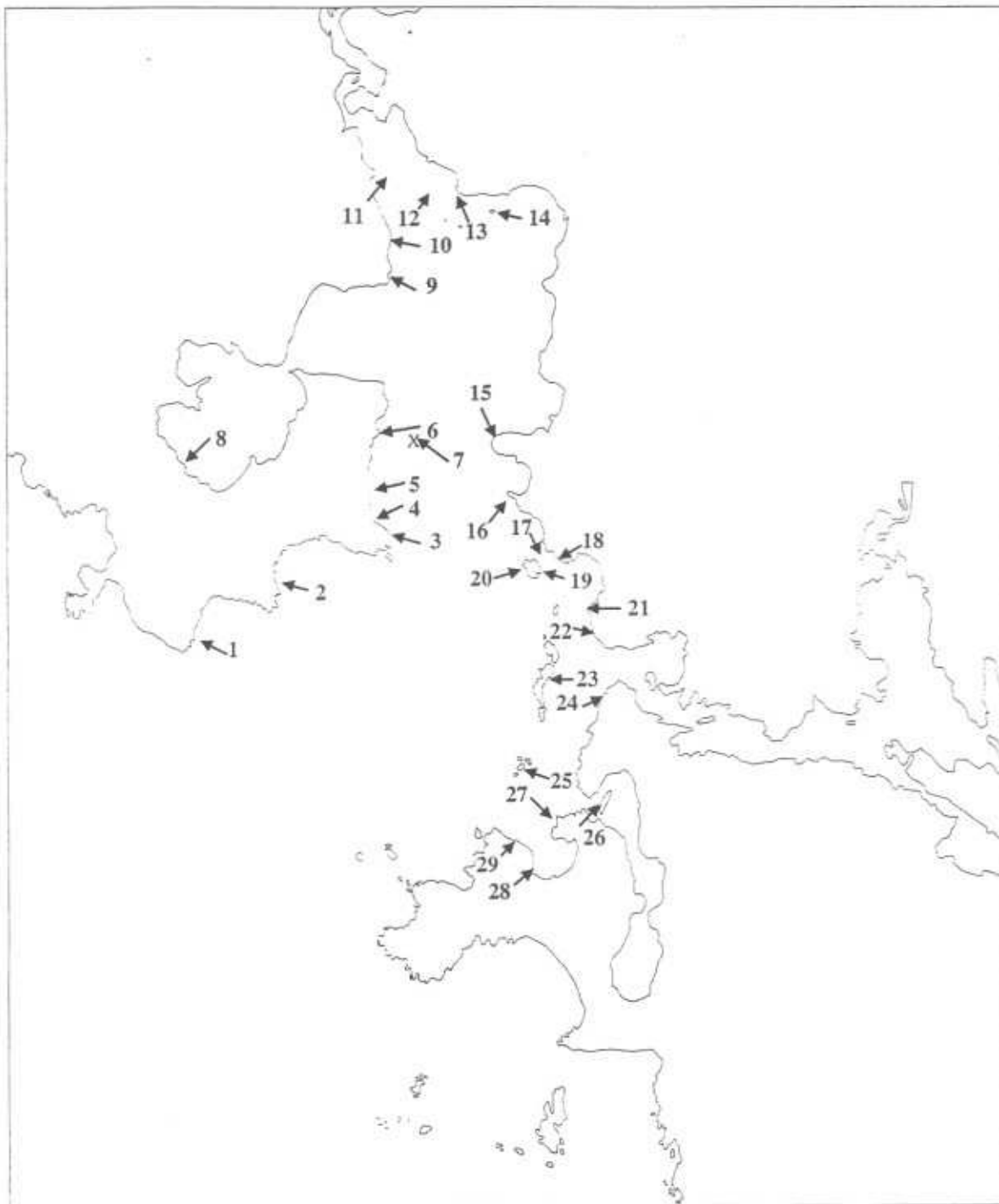


Figure 1. Qualitative survey sites in the Port Davey Region. Site names are listed in Table 1, and site descriptions in Appendix 1.

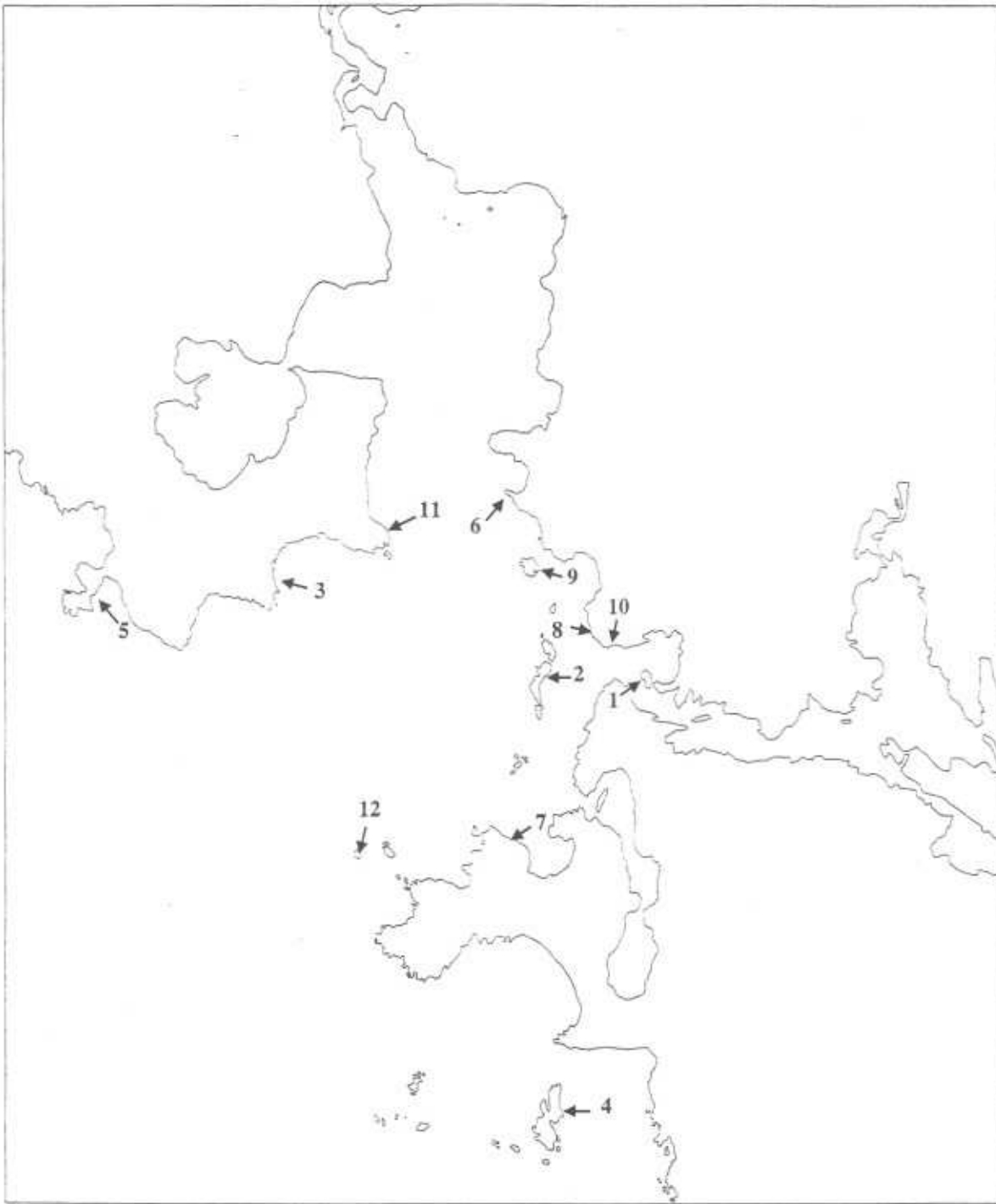
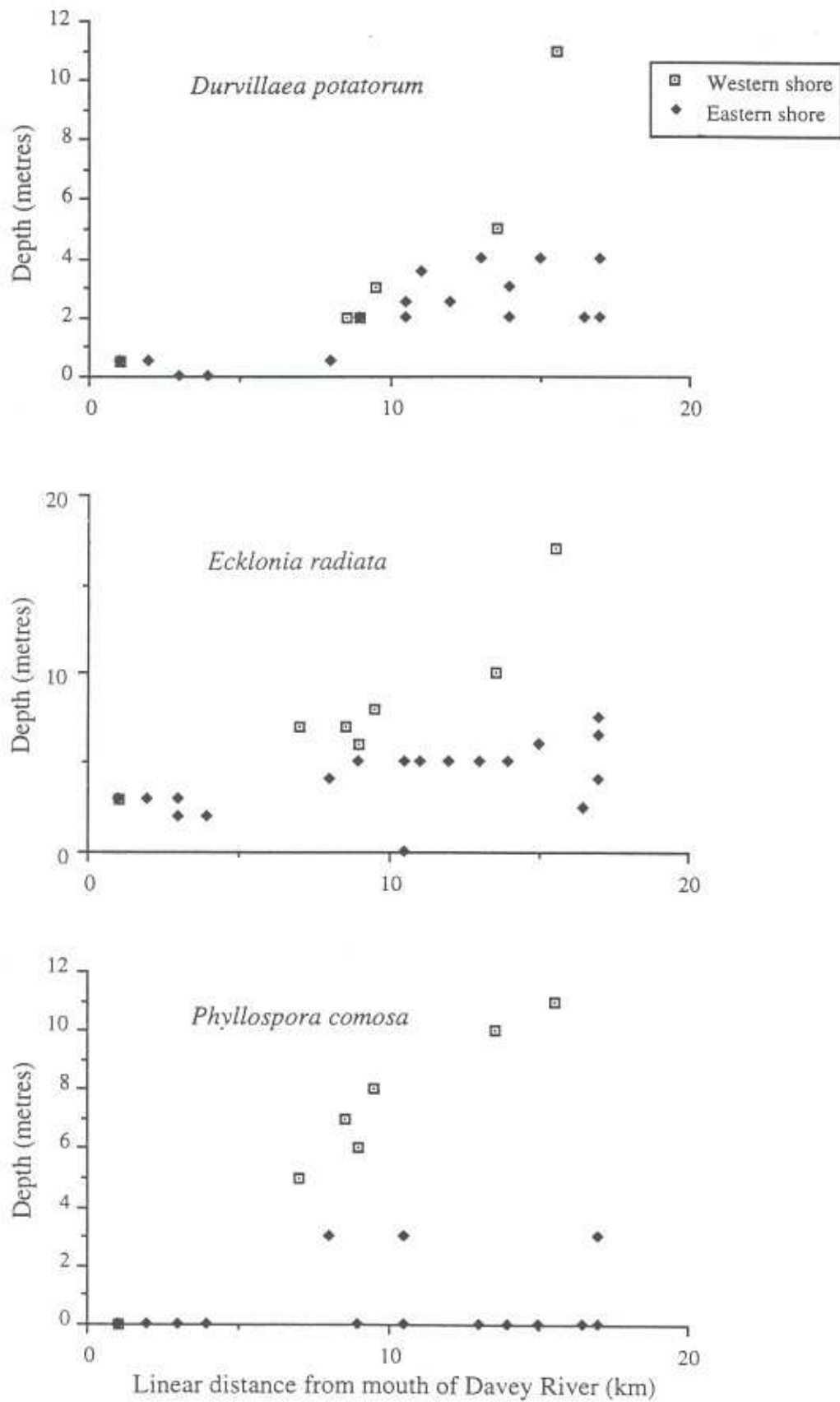


Figure 2. Quantitative survey sites in the Port Davey Region. Sites are (1) Sarah Is, (2) Breaksea Is, (3) Saddle Bight, (4) Muttonbird Is, (5) Rough Bay, (6) Ashley Pt, (7) Knapp Pt, (8) Milner Head (north), (9) Kathleen Is, (10) Milner Head (south), (11) Whalers Pt, (12) Big Caroline Rock.

Table 1. Maximum depth of reef, and of major algal species and algal groupings, at quatitative transect sites in Port Davey, March 1998. The position of sites is shown in Figure 1.

Site No.	Site description	Max Depth (m)	D u r v i l a e a	E c k l o n i a	C a r p o l o s s u m	P h y l o s p o r a	T h a m n o c l o n i u m	R e d s
1	Outer Saddle Bight	17	11	17+	17+	11	17+	17+
2	Saddle Bight	10	5	10+	10+	10+	10+	10+
3	Whalers Point	8	3	8+	8+	8+	8+	8+
4	0.5km north of Whalers Pt	6	2	6+	6+	6+	6+	6+
5	1 km north of Whalers Pt	7	2	7+	7+	7	7+	7+
6	1km south of Earles Pt	7		7+	7+	5	7+	7+
7	Patch Reef	7		7+	7+		7+	7+
8	Kelly Basin	2						
9	Curtis Pt	2	0			0		
10	1 km north of Curtis Pt	2.5	0	2	2	0		
11	1km south of Pebbly Beach		0.5	3	3	0	3	4
12	Offshore reef south of Pebbly Beach Bay	4	0.5	3	3	0	4+	4+
13	Fitzroy Pt	3	0.5	3	3	0		
14	Is east of Fitzroy Pt	?		3		0		
15	Berry Head	6	0.5	4	4	3	6+	6+
16	Ashley Pt	6.5	2	5	5	0	6.5+	6.5+
17	Mavourneen Rocks	5		5+	5+	3	5+	5+
18	Inside Kathleen Is	10	3.5	5	6	0	9+	9
19	Pt opposite Kathleen	10	2.5				10+	10+
20	Outer Kathleen Is	18	2	0	0	0	10+	7+
21	Pt south of Toogelow Beach	9	2.5	5	5	0	9	9
22	Milner Head (north)	6	4	5	5	0	6+	5
23	Inside Breaksea Is	7	2	5	5	0	5	5
24	Turnbull Head	8	3	6	6	0	8+	8+
25	Inside Shanks Is	8	4	6	6	0	8+	8+
26	Lourah Is	5	2	2.5	2.5	0	5+	5+
27	Hannant Pt	13		6.5	6.5	0	13+	8+
28	Spain Bay, western shore	4	3	4+	4+	3	4+	4+
29	Knapp Pt	9	2	7.5	7.5	3	8+	8+

Figure 3. Maximum depth of three dominant species of algae in Port Davey as a function of distance from the mouth of the Davey River.



## Results and Discussion:

### *The influence of tannin water.*

The most notable influence of tannin-stained waters in Port Davey on reef communities is shown by the macroalgal distribution. Species such as *Ecklonia radiata* and *Carpoglossum confluens* that can extend into depths of 30 m or more in clear coastal waters are restricted to 5 m or less in many parts of Port Davey (Table 1), presumably due to the restricted light regime. Although the degree of exposure can influence the maximum depth that these species reach (Edgar 1994b), most of the sites were sufficiently exposed for *Ecklonia* and *Carpoglossum* to be found at 15 m or more under normal conditions. This influence can be clearly seen in Fig. 3. The maximum depths of *Durvillaea*, *Ecklonia*, and *Phyllospora* increase with increasing distance from the sources of tannin water, the Davey River, and Bathurst Channel (entering at 12 km from the mouth of the Davey River). Figure 3 also shows that the maximum depths of these algae are substantially greater on the western shore of Port Davey than the eastern shore, indicating that the tannin waters predominantly flow along the ~~western~~<sup>eastern</sup> shoreline and to the south. For much of the western shore from Earles Pt south, the macroalgal community may not be substantially altered by tannin waters, and instead maximum depths along this coast are more often restricted by the maximum depth of the reef than by available light. However, on the eastern shore, the algal communities from Fitzroy Pt to Spain Bay appear to have been substantially altered as a consequence of the tannin water. At these sites the dominant macroalgal community is typically *Durvillaea* from 0 m to 2-3 m, *Ecklonia* and *Carpoglossum* from 2 m to 5-6 m, mixed red algal species to 7 m, the sponge/algal associate *Thamnoclonium* to 8 m, with invertebrates being the only cover at depths greater than 8 m. This distribution is truncated by the absence of reef below 5 m at many sites. (Specific site details are given in Appendix 1).

One of the more unusual algal communities identified was found on the western side of Kathleen Is, where exposure is sub-maximal to maximal. On a typical coast at such a site, brown algae would be found to at least 30 m, with *Durvillaea* extending to at least 10 m. However at western Kathleen Is, *Durvillaea* was the only brown algae recorded, and its distribution extended only to 2 m, with red algae extending to 7 m, and *Thamnoclonium* to 10 m. This unique community appears to be structured by the unusual combination of a high energy coastline, and extreme light absorption. Light availability appears to limit the lower distribution of *Durvillaea*, while the combination of low light and exposure precludes all other brown algae. In a similar manner, the tannin water along eastern Port Davey substantially limits the distribution of *Phyllospora comosa* (Fig 3). This coastal species that usually dominates large areas of space on coastal reefs was present at all sites along the western shore, but absent from



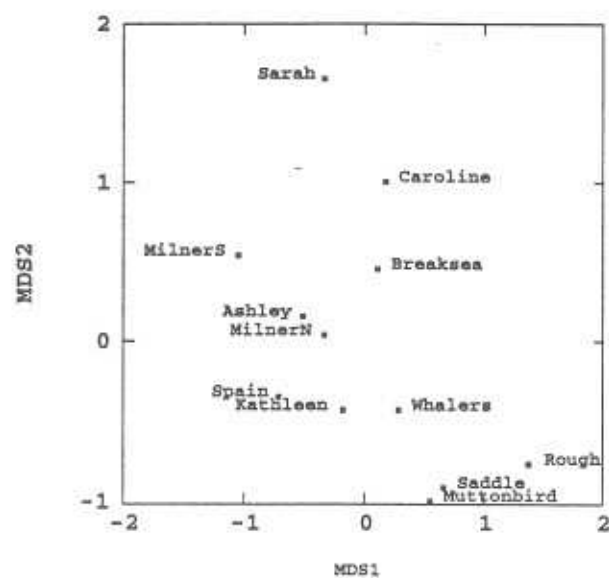
most sites along the eastern shore even though it would normally be present at sites of similar exposure. *Phyllospora* requires more light than *Ecklonia* (see Edgar 1984b), and appears to be replaced by *Ecklonia* when light is limited either by depth or by water clarity.

The relationship between sites was examined using data for algal percent cover, which was analysed using MDS (Fig. 4). The stress associated with this plot was 0.07, suggesting that the plot provided a good indication of the relationship between sites. The three sites most removed from the influence of tannin water, and subject to the maximal degree of exposure are clearly associated (Saddle Bight, Muttonbird Is, Rough Bay). The remaining sites are distributed along a gradient of decreasing exposure and increasing influence of tannins, towards the moderately sheltered, strongly tannin-influenced waters of Sarah Is. The western shore Whalers Pt site has a greater similarity to the open coast sites than to similarly exposed eastern shore counterparts, presumably due to the decreased influence of tannin water along the western shore. The Big Caroline Rock site has separated from other exposed sites, primarily because it was surveyed at 10 m rather than at 5 m as at the remaining sites.

#### *Exposure.*

The macroalgal community present at a particular location is often a good indication of the extent that a site is exposed to swells and seas. However, in inner Port Davey this relationship is complicated by the strong influence that the tannin-waters have on the algal communities, particularly in limiting the lower distribution of key indicator species such as *Durvillaea*. The presence of *Durvillaea* indicates that a coastline is in the range from moderately exposed to maximally exposed, while the maximum depth that *Durvillaea* reaches is an indication of the sites position along the exposure gradient. *Durvillaea* was present at most locations surveyed within Port Davey, and ranged from a maximum depth of 0.5 m at Berry Head to 11 m at Outer Saddle Bight, a depth typical of maximally exposed coastline. The only locations surveyed where *Durvillaea* was absent was at Kelly Basin, and from Curtis Pt towards Pebbly Beach Bay. Presumably the section of coastline from Earles Pt north to Pebbly Beach Bay could be considered to be sheltered to moderately exposed open coast. Hannant Inlet and the eastern shore of Lourah Is would be in the same category, although *Durvillaea* is present to 1 m on the western coast of Lourah Is. *Durvillaea* was present from Fitzroy Pt (0.5 m) south along the entire eastern shoreline of Port Davey, and presumably there is a gradient from moderate to maximal exposure along this shoreline from Fitzroy Pt to Hilliard Head, modified in places by the shelter afforded by islands such as Breaksea, and headlands such as Berry Head.

Figure 4. Results of MDS using log-transformed % cover of macroalgal species at quantitatively surveyed sites in Port Davey. Site positions are shown in Figure 2.



*Reef depth distribution, offshore development, and structure.*

Much of the inner portion of Port Davey consists of shallow sandy bottom, with reefs fringing the shoreline. Reefs in the northern section are shallow, ranging from 2-3 m at the sand edge at Curtis Pt and Fitzroy Pt through to 8 m at Whalers Pt and Turnbull Head. The exceptions to this are the western shorelines of Breaksea Is and Kathleen Is, where reefs extend to 18 m depth. In outer Port Davey, maximum reef depth gradually increases and reaches 17 m at Outer Saddle Bight and at Big Caroline Rock. For most of this coastline the offshore development of reef appears to be limited, with few places surveyed having an offshore reef development of 100 m or more. The extent of reef between Earles Pt and Whalers Pt is extremely limited, with the coastline being either beach or having reef extending only 5 m offshore at most locations. Most reef surveyed had moderate structural complexity, consisting of metamorphosed rocks typical of this region. However, with the exception of the sites examined at Ashley Pt and Lourah Is, few sites had any notable development of cave or crevice structure offering shelter to the fish and invertebrate communities.

*Range of habitats and communities present.*

The western shore of Port Davey offers a wide range of representative reef and sediment habitats, ranging from sheltered habitats in Kelly Basin and Bond Bay, through to maximally exposed habitats at Outer Saddle Bight, although the extent of sheltered to moderately exposed reef appears to be restricted. The most sheltered reefs are found in Kelly Basin and Bond Bay but are extremely limited in overall area and depth range. Most of these reefs extend to only 2 m depth. Likewise, moderately exposed reefs extend between Whalers Pt and Pebbly Beach Bay, but with the exception of Whalers Pt the remaining reefs either possess little overall area (Whalers Pt to Earles Pt) or are very shallow (2-3 m max., from Curtis Pt to Pebble Beach Bay) and influenced by tannin waters.

On the eastern shore of Port Davey the moderately exposed habitats (ie. those north of Berry Head and sections of coastline protected by islands) are substantially altered by the presence of tannin-stained waters, and must be considered to be an extension of the unique ecosystem generated by the tannin waters. These habitats are represented by a substantial area of reef coverage, and include depths ranging down to 8 m at Turnbull Head. The tannin-water influence extends to at least Shanks Islands, Breaksea Is, and Kathleen Is, and the outer coasts of these islands contain sub-maximally to maximally exposed habitats to 17 m depth..

Tables 2, 3 & 4 summarise the results from the quantitative surveys at 5 m sites, and give an indication of the communities present. At most sites examined (limited by the

Table 2. Total abundance at each site, of fish species counted on quantitative surveys at Port Davey. Sites are (1) Sarah Is, (2) Breaksea Is, (3) Saddle Bight, (4) Muttonbird Is, (5) Rough Bay, (6) Ashley Pt, (7) Knapp Pt, (8) Milner Head (north), (9) Kathleen Is, (10) Milner Head (south), (11) Whalers Pt, (12) Big Caroline Rock. Their positions are shown in Figure 2. All sites were surveyed at 5m, except Big Caroline Rock, surveyed at 10m. The dates of surveys are 3/98 (sites 6,7,8,9,10,11), 5/94 (sites 4,5), and 4/93 (sites 1,2,3,12).

Site	1	2	3	4	5	6	7	8	9	10	11	12
Species												
<i>Apogon conspersus</i>	2	0	0	0	0	0	0	0	0	0	0	0
<i>Aracana aurita</i>	0	0	0	0	1	0	0	0	0	0	2	0
<i>Caesioperca rasor</i>	0	0	0	0	0	0	0	0	0	0	0	1
<i>Cheilodactylus spectabilis</i>	0	0	0	0	0	1	0	0	0	0	0	0
<i>Dactylosargus arcidens</i>	0	0	1	1	0	0	1	0	0	0	0	0
<i>Dinolestes lewini</i>	0	3	0	0	0	0	0	0	0	0	0	0
<i>Diodin nichthemerus</i>	0	0	1	1	0	0	0	0	0	0	1	0
<i>Latridopsis forsteri</i>	0	0	0	5	2	0	0	1	0	0	0	6
<i>Latris lineata</i>	0	0	0	25	1	0	0	8	0	0	0	0
<i>Meuschenia australis</i>	1	0	1	0	0	0	0	0	0	0	0	0
<i>Nemadactylus macropterus</i>	0	0	0	0	0	0	0	0	0	16	0	0
<i>Neosebastes scorpaenoides</i>	1	0	0	0	0	0	0	0	0	0	0	0
<i>Nesogobius hinssbyi</i>	3	0	0	0	0	0	0	0	0	0	0	0
<i>Notolabrus fucicola</i>	6	53	39	30	55	31	48	35	9	22	19	20
<i>Notolabrus tetricus</i>	1	0	0	6	4	4	1	1	2	6	2	6
<i>Odax cyanomelas</i>	0	0	0	0	0	0	0	0	0	0	2	0
<i>Pseudolabrus psittaculus</i>	4	0	0	0	0	0	0	0	0	14	2	13
<i>Pseudophycis bachus</i>	1	0	0	0	0	0	0	0	0	0	0	0
<i>Scorpaena ergastulorum</i>	1	0	0	0	0	0	0	0	0	0	0	0
<i>Trachinops caudimaculatus</i>	32	0	0	0	0	0	0	20	0	119	0	0
<i>Tracurus declivus</i>	0	450	0	0	0	0	0	0	0	0	0	0
<i>Urolophus cruciatus</i>	0	0	0	0	0	0	0	1	0	0	0	0

Table 3. Total number of invertebrates and cryptic fish counted at each site quantitatively surveyed in Port Davey. Sites are (1) Sarah Is, (2) Breaksea Is, (3) Saddle Bight, (4) Muttonbird Is, (5) Rough Bay, (6) Ashley Pt, (7) Knapp Pt, (8) Milner Head (north), (9) Kathleen Is, (10) Milner Head (south), (11) Whalers Pt, (12) Big Caroline Rock. Their positions are shown in Figure 2. All sites were surveyed at 5m, except Big Caroline Rock, surveyed at 10m. The dates of surveys are 3/98 (sites 6,7,8,9,10,11), 5/94 (sites 4,5), and 4/93 (sites 1,2,3,12).

Site	1	2	3	4	5	6	7	8	9	10	11	12
<b>Species</b>												
<b>Cryptic fish</b>												
<i>Ghathanacanthus goetzii</i>	0	0	1	0	0	0	0	0	0	1	0	0
<i>Heteroclinus johnstoni</i>	0	0	0	0	0	0	0	1	0	0	0	0
<i>Norfolkia striaticeps</i>	0	0	0	0	0	0	0	0	0	1	0	0
<i>Pseudophycis bachus</i>	0	0	0	1	0	0	0	0	0	0	0	0
<i>Scorpaena ergastulorum</i>	0	0	2	0	0	0	0	0	0	0	0	7
<b>Invertebrates</b>												
<b>Molluscs</b>												
<i>Amorena undulata</i>	1	0	0	0	0	0	0	0	0	0	0	0
<i>Argobuccinum vexillum</i>	0	0	0	0	0	0	0	0	1	0	0	0
<i>Cymatium sprengleri</i>	2	1	0	0	0	0	1	0	0	3	0	0
<i>Haliotis rubra</i>	1	3	25	12	32	4	3	6	14	0	22	2
<i>Thais orbita</i>	0	3	0	0	0	0	0	0	0	0	0	0
<i>Turbo undulatus</i>	0	0	2	2	828	0	0	0	0	0	0	0
<b>Echinoderms</b>												
<i>Austrastole scabra</i>	0	0	0	0	1	0	0	1	0	0	0	0
<i>Comanthus trichoptera</i>	0	1	0	0	0	0	0	0	0	0	0	0
<i>Goniocidaris tubaria</i>	86	1	0	0	0	0	0	0	0	6	19	2
<i>Heliocidaris erythrogramma</i>	12	0	0	0	0	0	0	0	0	1	0	2
<i>Holopneustes inflatus</i>	0	0	0	0	0	0	0	0	4	0	4	0
<i>Nectria oscillata</i>	0	0	2	7	0	8	2	0	0	0	0	0
<i>Pentagonaster duebeni</i>	2	2	0	0	0	5	1	0	0	0	0	11
<i>Petricia vernicina</i>	0	0	8	0	0	5	3	0	0	0	2	5
<i>Tosia australis</i>	4	0	0	0	0	0	0	0	0	0	0	0
<i>Tosia magnifica</i>	3	0	0	0	0	0	0	0	0	0	0	0
<b>Crustaceans</b>												
<i>Jasus edwardsii</i>	2	3	9	9	14	3	1	6	0	7	7	20
<i>Nectocarcinus tuberculata</i>	0	0	0	0	1	0	0	0	0	0	0	0
Pagurid spp.	0	0	2	0	0	1	0	0	0	0	1	0
<i>Plagusia chabrus</i>	0	0	1	0	0	0	2	0	0	0	2	1



Table 4. Percentage cover of macroalgae recorded at quantitative transect sites in Port Davey. Sites are (1) Sarah Is, (2) Breaksea Is, (3) Saddle Bight, (4) Muttonbird Is, (5) Rough Bay, (6) Ashley Pt, (7) Knapp Pt, (8) Milner Head (north), (9) Kathleen Is, (10) Milner Head (south), (11) Whalers Pt, (12) Big Caroline Rock. Their positions are shown in Figure 2. All sites were surveyed at 5m, except Big Caroline Rock, surveyed at 10m. The dates of surveys are 3/98 (sites 6,7,8,9,10,11), 5/94 (sites 4,5), and 4/93 (sites 1,2,3,12).

Site	1	2	3	4	5	6	7	8	9	10	11	12
Species												
Invertebrates												
Bryozoa	21	1.3	0.3	0	0	0	0	0	0	0	0	11
Sponges	8.6	1	0	0	0	0	0	0	0	0	0	9.3
<i>Carteriospongia calcyformis</i>	1.9	0	0	0	0	0	0	0	0	0	0	0
Alcyonarians	0.8	0	0	0	0	0	0	0	0	0	0	0
<i>Mopsella</i> sp.	1.2	0	0	0	0	0	0	0	0	0	0	0
<i>Capnella</i> spp.	0	0.2	0	0	0	0	0	0	0	0	0	0.3
Hydroids	0	0	0	0	0	0	0	0	0	0	0	0.3
Ascidians	1.1	0.3	0	0	0	0	0	0	0	0	0	0.4
Brown algae												
<i>Acrocarpia paniculata</i>	0	0	0	0.8	0	0	0	0	0	0	0	0
<i>Carpoglossum confluens</i>	0	15	0.2	0.9	0	6.5	27	11	15	2	18	5.5
<i>Carpomitra costata</i>	0	0	0	0	0.4	0	0	0	0	0	0	0
<i>Cystophora platylobium</i>	0	0.6	4.1	1.6	1.7	0	0.5	0.3	0.9	0	2.5	0
<i>Cystophora xiphocarpa</i>	0	0	0	0.4	0.1	0	0	0	0	0	0	0
<i>Dictyopteris muelleri</i>	0	0	0	0	0	0.1	0	0	0	0	0	0
<i>Durvillaea potatorum</i>	0	0	4.2	0	30	0	0	0	0.2	0	0.5	0
<i>Ecklonia radiata</i>	0	18	4	20	0	1.6	29	2.5	4.2	5.1	18	0
<i>Lessonia corrugata</i>	0	0	9.4	8.2	4	0	0	0	0	0	9.8	0.3
<i>Macrocystis pyrifera</i>	0	0	0	0.5	0	0	0	0	0	0	0	0
<i>Perithalia cordata</i>	0	0	0	0	0	0.2	0	0	0	0	0	0
<i>Phyllospora comosa</i>	0	0	34	38	24	0	0	0	0.1	0	14	0
<i>Sargassum vestitum</i>	0	0	0.6	1.5	0	0	0	0	0	0	0	0
<i>Xiphophora gladiata</i>	0	0	11	10	4.5	0	0.3	0	0.4	0	4.3	0
<i>Zonaria turnerina</i>	0	0.1	0.1	0.1	0	0	0.4	0	0.1	0	0.1	0
Green algae												
<i>Caulerpa annulata</i>	0	0	0	0.3	0	0	0	0	0	0	0	0
<i>Caulerpa brownii</i>	0	0	0	1.6	0	0	0	0	0.6	0	0	2.2
<i>Caulerpa geminata</i>	3	1.2	0	0.1	0	5.1	0	1.5	0.4	3.2	1.4	0.4
<i>Caulerpa longifolia</i>	0	0	0	0	0	0	0	0.3	0	0	0	0
<i>Caulerpa simpliscuscula</i>	0	0	0	0.3	0	0	0	0	0	0	0	0
<i>Caulerpa trifaria</i>	0	0	0	0	0	0	0	1.3	0	0	0	0
<i>Codium pomoides</i>	0.1	0.1	0	0	0	0.6	0.2	0	0.4	0.5	0	0
Red algae												
<i>Areschougia</i> sp.	0	0	0	0.4	6.5	0.7	1	3.9	0	0	3.2	0
<i>Ballia callitrichia</i>	0	0.7	4	5.1	2.1	1.3	0.6	0.6	2.2	0.4	2.3	0
<i>Ballia scoparia</i>	0	0	0	7.5	1.5	0	0.5	0.5	1.9	0	8.6	0
<i>Bangia</i> spp.	0	0	0	0.7	0	0	0	0	0	0	0	0
<i>Champia</i> spp.	0	0	0	0	0	0.6	0.2	0.5	0.3	0.1	0	0
Coralline reds	0	0.8	1.9	2.1	16	0	0	0.2	0.9	0.3	0.6	0.1
<i>Delisea pulchra</i>	0	0	0	0	0	0.2	0	0.1	0	4	0	0.4
<i>Dictyomenia harveyana</i>	0.1	0	0	0	0	0	0	0	0	0.1	0	0
<i>Gelidium glandulaefolium</i>	0	0	0	0	0	0	0	0	8.6	0	0	0
<i>Gelidium</i> spp.	0	0	0	0	2.5	0	0	0	0	0	0	0
<i>Halcinide similans</i>	0	0	0	0	0	0	0	0	0	0.1	0	0
<i>Halitaton</i> sp.	0	0	0	0	0	0.3	2.6	0	0	0	0	0
<i>Hemineura frondosa</i>	0	0	0.7	0.1	0.1	0.5	0.1	0.6	0.6	0.1	0.2	0

<i>Hypnea episcopalis</i>	0	0	0.9	0.6	0	0	0	0	0	0	0	0
<i>Jeanneretia lobata</i>	0	0	2.1	0	0	0	0	0	0	0	0	0
<i>Laurencia spp.</i>	0	0	0	0.1	0	0	0	0	0	0	0	0
<i>Lenormandia marginata</i>	0.3	0	0	0	0	1.9	0.1	0.7	0.3	2.3	0.3	0.5
<i>Lenormandia muelleri</i>	0	0	4	0.8	0	0	0	0	0	0	0	0
<i>Melanthalia obtusata</i>	0	2.2	0	0.2	0	0	0	0	1.3	0	0	2.9
<i>Metagoniolithon stelliferum</i>	0	0	0	0	0	0	0.5	0	0	0	0	0
<i>Metamastophora</i>	0	0	0	0	0	0	0.5	0	0	0	0	0
<i>Peyssonnelia/Sonderopelta</i>	0	8.3	0	0	0	0	0	0	0	0	0	5.2
<i>Peyssonnelia australis</i>	0	0	0	0.4	0	9.5	17	0.6	3.2	0.2	2.8	0
<i>Phacellocarpus labillardieri</i>	0	7.3	3.3	3.4	0	3.2	1	0.2	0.1	0	3.8	0.6
<i>Plocamium angustum</i>	1.6	1.7	8	4.4	1.6	1.4	0.3	7.3	9.8	0	7.4	1.2
<i>Plocamium costatum</i>	0	0	0.2	0	0	0.3	0	0.2	0	0	0	0
<i>Plocamium dilatatum</i>	0	0.1	0	1.5	1	0	0	0	0	0	0.5	0
<i>Plocamium leptophyllum</i>	0	0	0	0	0	0.2	0	0	0	0.8	0	0
<i>Plocamium cartilagineum</i>	0	0	0.3	0	0	0	0	0	0.1	0	0	0
<i>Ptilonia australicum</i>	0	0	0.4	1.2	0	0	0	0.5	0.1	0	0.3	3.4
<i>Rhodomenia australis</i>	0	0.1	0	2.8	0.8	0	0	0	0	0.1	0	0
<i>Sonderopelta corioacea</i>	0	0	0	1.7	0	0	0	0	0	0.5	0	0
<i>Thamnoclonium dichotomum</i>	13	3.4	0	0	0	13	3.5	7.9	0.7	16	1.7	21
Unid. thallose reds	0.8	7.4	16	2.6	1.2	8.2	2.5	4.2	5.3	0.6	6.2	13

presence of reef at 5 m) the algal community was dominated by *Ecklonia* and *Carpoglossum*, with *Durvillaea* becoming more abundant at the most exposed sites, and *Phyllospora* being common at the clear water sites. The exception to this was at Sarah Is, where strong tannin-stained waters prevent brown algae from growing to 5 m but are replaced by the red algae/sponge associate *Thamnoclonium*.

At most sites a substantial diversity of red algal species was recorded. The fish community was lacking in diversity at all sites, and was typically dominated by *Notolabrus fucicola*, with *Notolabrus tetricus*, and *Pseudolabrus psittaculus* less common, and occasional sightings of exposed water species such as *Trachurus declivus*, *Latris lineata* and *Latridopsis forsteri*. Common invertebrates at most sites were *Haliotis rubra* and *Jasus edwardsii*, with other species such as the periwinkle *Turbo undulatus* and the pencil urchin *Goniocidaris tubaria* locally abundant.

The results from the qualitative surveys are similar to those from the quantitative surveys at 5 m (see Appendix 1). They also show that there are substantial changes below 5 m, particularly in the areas strongly influenced by tannin waters, and that algal communities are gradually replaced by animal communities between 5 and 10 m depth in these areas, particularly in the area bounded by Kathleen Is and Shanks Islands. For fish, there is a gradual shift between 5 and 10 m depth with *Notolabrus fucicola* replaced by *N. tetricus* and *Pseudolabrus psittaculus*, as well as increasing numbers of other species such as *Meuschenia australis* and *Diodon nichthemerus*.

#### *Summary of survey results.*

The survey identified Port Davey as being divisible into two distinct zones, the western shore, containing habitats representative of the bioregion, and the eastern and northern shores, containing habitats highly modified by the influence of tannin-stained surface waters. The discharge waters from the Davey River and Bathurst Channel appear to flow predominantly southward along the eastern shoreline, and although this influence is diminished with distance, algal communities are still notably influenced as far seaward as Big Caroline Rock. The "representative" habitats available within Port Davey range from sheltered (Kelly Basin, Bond Bay), through moderately exposed (Pebbly Beach Bay to Whalers Pt), to sub-maximally to maximally exposed (outwards from Whalers Pt), although the extent of reef habitat within the sheltered to moderately exposed categories is extremely limited in both areal coverage and the range of depths represented. *Macrocystis pyrifera* kelp forests, an important habitat type of moderately exposed coasts of this bioregion, are only represented in Port Davey by a few isolated plants in shallow water, presumably due to the lack of suitable depth reef at sites with the moderate exposure that this species requires.



Along the eastern shoreline of Port Davey, most reef habitats are strongly influenced by tannin-waters and can be considered to be part of an exposed coast extension of the "unique" ecosystem in Bathurst Channel and Bathurst Harbour. The outer coasts of Kathleen Is and Breaksea Is are sub-maximally to maximally exposed examples of this, containing unique marine communities extending to 17 m depth, and these should be considered an important component of any reserve aiming to protect this unique ecosystem.

All sites examined in Port Davey had a low mobile invertebrate and fish diversity, a typical result for this bioregion, presumably due to the influence of high energy swells. While deeper reefs (e.g. 17 m at Outer Saddle Bight) offer a refuge from turbulent waters and appear to have a comparatively higher diversity, Port Davey is quite shallow, and the majority of reefs are in less than 10 m of water. In contrast to the number of mobile invertebrates, the diversity of sessile invertebrate species (such as sponges, ascidians, cnidarians) in shallow depths appears to be extremely high, particularly along the eastern Port Davey coast. However, this component of the fauna was not quantified in the present study.

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*Limitations of the survey.*

This survey was intended to, and does, provide sufficient information on the distribution of reef area and habitat types within Port Davey to assist with management decisions relating to suitable boundaries for a proposed marine reserve within the region. It is not a comprehensive survey of the biota present, or of all reef area.

*Identification of locations within Port Davey with high conservation significance.*

The coastline centred around the entrance to Bathurst Channel, extending from the northern point of Kathleen Is, through Breaksea Is, to the southern point of the Shanks Islands, including the exposed western coasts of these islands, has high conservation significance. It contains a range of unique tannin-water habitats including examples of shallow and moderately deep reef, with exposures varying from moderate to sub-maximum. This is an exposed coast extension of the tannin-influenced sheltered water ecosystem found in Bathurst Channel and Bathurst Harbour and should be included with them in any marine reserve proposal designed to protect the tannin water ecosystem.

Kelly Basin provides an excellent example of an undisturbed estuarine inlet for this bioregion, and contains a wide range of habitats, including shallow reef, and shallow to moderately deep sediment habitats. It has high conservation significance in that it is undisturbed and could add a substantial range of habitats if included in a representative marine reserve. Hannant Inlet is of less value in fulfilling this role as it is very shallow with little habitat diversity.

The extremely limited area and depth range of sheltered and moderately exposed reef on the western shore of Port Davey limits the conservation value of this area for protecting these habitats in the Davey Bioregion, particularly as *Macrocystis pyrifera* kelp forests, a major habitat type of this bioregion are virtually absent. These areas are unlikely to have any special conservation significance, and better examples of these habitat types may be available for conservation elsewhere in the bioregion. The outer coast of Port Davey seaward of Whalers Pt offers good representative examples of sub-maximally to maximally exposed coastline, and although limited in maximum depth, would be suitable for inclusion in a reserve aiming to protect representative examples of such habitats. This exposed coastline is typical of much of the exposed coast in this region and has no greater or lesser conservation significance.

*Recommendations for future management and research.*

The coastline centred around the entrance to Bathurst Channel, extending from the northern point of Kathleen Is, through Breaksea Is, to the southern point of the Shanks Islands, including the exposed western coasts of these islands, should be included as an important and major component of the "unique" tannin-stained water marine reserve proposal.

Kelly Basin and the exposed coastline seaward of Whalers Pt contain good examples of 'representative' estuarine and exposed coast habitats in the Davey Bioregion, and would make valuable contributions to conservation if included in a representative marine reserve. Sheltered to moderately exposed reef habitats are under-represented in Port Davey, and a key habitat, *Macrocystis* kelp forest, is missing. These habitats may be better represented in other areas within the Davey Bioregion, and incorporated into a separate reserve proposal.

Future research should concentrate on the identification of suitable areas in the Davey Bioregion where representative habitats, not included or adequately represented in a final Port Davey proposal, can be protected.

## Appendix 1. Site and community descriptions for qualitative survey sites

Site 1: Outer Saddle Bight, western shore

Grid Ref: 55G0408701 5203183

Offshore extent of reef: 100-150m

Maximum depth: 17m

Reef structure: Moderate with some cave and crevice development at middle depths.

Algae present:

At 17m *Ecklonia* with sparse *Carpoglossum*, *Cystophora platylobium*, and *Macrocystis*, with mixed reds.

At 14m, *Durvillaea* entering.

At 11m, mixed *Durvillaea*, *Ecklonia*, *Macrocystis*, *Phyllospora*, and *Carpoglossum* with *Acrocarpia* and *Caulerpa flexillis*, with diverse reds.

At 8m mixed *Durvillaea* and *Phyllospora*, with *Caulerpa flexillis* on walls. Some *Lessonia*, *Xiphophora* and *Carpoglossum*, and many mixed reds.

At 5m and above *Durvillaea*, with some reds.

Fish: On the deeper parts of reef, *Pseudolabrus psittaculus* common, some *Latridopsis*, *N. tetricus* and *Meuschenia australis*. Schools of *Dinolestes lewinii* extending from deep to shallow reef. In shallow (8m), *N. fucicola* becoming common, with *Diodon*, *Dactylosargus*, and *Aracana aurita* present.

Invertebrates: Some *Halotis* present, moderate numbers of *Pentagonaster* on deeper reef, and *Jasus* common in caves in middle depths.

Site 2: Saddle Bight, western shore

Grid Ref: 55G0410368 5204138

Offshore extent of reef: 50m

Maximum depth: 10m

Reef structure: Slight to moderate

Algae present:

At 10m, *Ecklonia*, *Phyllospora*, *Carpoglossum* and diverse reds (including *Lenormandia muelleri*, *Callophyllis* sp., and *Plocamium* spp.).

At 6m, *Phyllospora*, *Ecklonia*, and some *Xiphophora* and *Carpoglossum*.

At 5m, *Durvillaea*, and *Phyllospora*.

0-3m *Durvillaea*, with sparse *Macrocystis* at 3m.

Fish: On the deeper parts, *N. fucicola* common. *Meuschenia australis*, *Pseudolabrus psittaculus*, *N. tetricus*, and *Diodon* present. *Notolabrus fucicola* abundant in shallow.

Invertebrates: Some *Halotis* from 3m up.

Site 3: Whalers Pt

Grid Ref: 55G0412787 5205251

Offshore extent of reef: 28m

Maximum depth: 8m

Reef structure: Moderate.

Algae present:

At 8m, *Carpoglossum*, *Ecklonia*, and *Phyllospora* (20%), with mixed reds (60%).

3-6m, mostly *Phyllospora*, with some *Ecklonia* and mixed reds.

0-3m, mostly *Durvillaea* with some *Phyllospora* at lower margins.

Fish: *N. fucicola* moderately common, with occasional *Latridopsis*, *Pseudolabrus psittaculus*, *Odax cyanomelas*, *Aracana ornata*, and *N. tetricus*.

Invertebrates: Moderate *Halotis* numbers, and occasional *Jasus*.

Site 4: North of Whalers Pt  
Grid Ref: 55G0412518 5205603

Offshore extent of reef: 4-15m (varies, patch reef extending from otherwise thin reef).  
Maximum depth: 6m  
Reef structure: Low reef.

Algae present:  
3-6m, *Ecklonia*, *Phyllospora*, *Carpoglossum*, and occasional *Macrocystis*,  
2-3m, mostly *Phyllospora*.  
0-2m, mostly *Durvillaea*.

Fish: *Notolabrus fucicola*, with some *Latridopsis*.

Invertebrates: *Halotis* sparse, mostly at 3m.

Site 5: Coast 1 km north of Whalers Point  
Grid Ref: 55G0412511 5206141

Offshore extent of reef: 20m  
Maximum depth: 7m  
Reef structure: Low towards sand edge, grading to moderate.

Algae present:  
At 7m, *Carpoglossum*, *Ecklonia*, some *Phyllospora*, and reds, particularly encrusting corralines.  
5-6m, *Carpoglossum*, *Ecklonia*, *Phyllospora*, *Cystophora platylobium*, and occasional *Macrocystis*.  
2.5-5m, mostly *Phyllospora*, some *Macrocystis* from 3-4m.  
0-2m, mostly *Durvillaea*.

Fish: *Notolabrus fucicola* common, *N. tetricus*, *Latridopsis* and rusty catshark present.

Invertebrates: *Halotis* moderately common, some *Goniocidaris* and *Petrecia*.

Site 6: Coast 1 km south of Earles Point  
Grid Ref: 55G0412739 5207516

Offshore extent of reef: ?  
Maximum depth: 7m  
Reef structure: Low at 7m, increasing to moderate at 5m.

Algae present:  
At 7m, *Ecklonia*, *Carpoglossum*, and reds (*Melanthalia*, *Thamniclinium*, *Jenerettia*, *Callophyllis*, etc),  
some *Caulerpa trifaria*, *C. flexillis*, and i  
At 5m, *Lessonia*, *Ecklonia*, *Carpoglossum*, *Sargassum verruculosum*, *Acrocarpia*, *Cystophora*  
*platypobium*, and sparse *Macrocystis* and *Phyllospora*, with *Codium pomoides*, and *Caulerpa brownii*.

Fish: *N. fucicola*, *N. tetricus*, and *Raja lemprieri*.

Invertebrates: -.

Site 7: Patch reef in open water, 1 km south of Earles Point  
Grid Ref: 55G0412983 5207417

Offshore extent of reef: Patch reef  
Maximum depth: 7m  
Reef structure: Moderate relief with few crevices.

Algae present:



At 7m, *Ecklonia*, *Carpoglossum*, with crustose corralines, some reds including *Melanthalia*, *Callophyllis*, *Gigartina gigantea*.

Fish: *N. fucicola* with occasional *Diodon*.

Invertebrates: *Petrecia* and *Goniocidaris* common, some *Jasus* and *Heliocidaris*.

Site 8: Southwestern Kelly Basin Reef  
Grid Ref: 55G040850 5206850

Offshore extent of reef: Patch reef, to 50m

Maximum depth: 2m

Reef structure: Low, flat.

Algae present:

At 2m, *Ecklonia*, *Sargassum verruculosum*, *Caulocystis cephalornithos*, and *Caulerpa geminata*, with sponges and patches of *Heterozostera*.

At 1m, *Ecklonia*, *Sargassum verruculosum*, *Carpoglossum*, *Caulocystis* and *Caulerpa geminata*.

Fish: *Neodax balteatus* common, some *Notolabrus fucicola* present..

Invertebrates: None observed.

Site 9: Curtis Point  
Grid Ref: 55G0413012 5211157

Offshore extent of reef: 10?m

Maximum depth: 2m

Reef structure: Moderate structure but few caves or crevices.

Algae present:

At 2m, moderate cover of browns *Phyllospora*, *Macrocystis*, *Ecklonia*, *Carpoglossum* and *Perithalia*, in decreasing abundance. Rocks encrusted in corraline algae but no other reds.

At 1m, *Macrocystis pyrifera* and *Xiphophora gladiata* common with sparse cover of the red *Ballia callitrichia*.

Fish: No fish sighted (restricted by 2m viz).

Invertebrates: *Pateriella calcar*, and *Turbo undulatus* common.

Site 10: Point 1km north of Curtis Point.  
Grid Ref: 55G0412885 5211979

Offshore extent of reef: 20m

Maximum depth: 2.5m

Reef structure: Moderate structure with occasional caves and crevices.

Algae present:

At 2.5m, low sandy reef with the red algae *Lenormandia marginata* present as a turf.

At 2m, *Ecklonia*, *Carpoglossum* and *Macrocystis* common with sparse cover of *Zonaria* and the red *Ballia callitrichia*.

At 1m, *Ecklonia*, *Carpoglossum*, and a mix of red algal species.

0-0.5m, *Xiphopora*, with some *Acrocarpia*, and mixed reds (including *Ballia callitrichia* and *Plocamium* spp.).

Fish: *Norfolkia striaticeps* the only fish species sighted.

Invertebrates: *Pateriella calcar* common.

Site 12: Offshore reef south of Pebbly Beach Bay.  
Grid Ref: 55G0412910 5213203

Offshore extent of reef: 25m  
Maximum depth: 4m  
Reef structure: Moderate structure with occasional caves and crevices.

Algae present:

At 4m, the reds *Ballia callitrichia* and *Rhodomenia australis*, and bryozoans.  
3-4m, mostly soft bryozoans and the reds including *Rhodomenia* and *Jenerettia lobata*.  
At 3m, lowest limit of *Ecklonia*, *Carpoglossum*, and *Macrocystis*, with some encrusting corallines and *Thamnoclonium*.  
At 2m, *Ecklonia*, *Acrocarpia*, *Carpoglossum*, and some *Macrocystis* present.  
At 1m, *Acrocarpia* and *Ballia callitrichia*, with some *Carpoglossum* and other reds.  
0-0.5m, *Durvillaea* with *Xiphophora* below.

Fish: None sighted.

Invertebrates: *Pateriella calcar* common, especially below 2m.

Site 13: Fitzroy Point.  
Grid Ref: 55G0414164 5212697

Offshore extent of reef: Patch reef  
Maximum depth: 3m  
Reef structure: ?

Algae present:

Below 3m, *Thamnoclonium*, bryozoans, sponges, bare rock.  
0.5-3m, *Carpoglossum*, *Ecklonia*, *Peyssonelia*, and *Ballia*.  
0-0.5m, *Durvillaea*.

Fish: Some *Latridopsis* sighted.

Invertebrates: None observed.

Site 14: Small island 1 km east of Fitzroy Point.  
Grid Ref: 55G0415115 5212441

Offshore extent of reef: ?  
Maximum depth: ?  
Reef structure: ?

Algae present:

At 3m, *Ecklonia*. No other observations due to less than 0.5m viz.

Site 15: Berry Head  
Grid Ref: 55G0415254 5207612

Offshore extent of reef: 30m  
Maximum depth: 6m  
Reef structure: At 6m, small rough pebbles. Above 6m, relatively smooth reef with few caves, crevices.

Algae present:

At 6m, some reds present including *Phacelocarpus* sp., and *Thamnoclonium* sp. Sparse *Caulerpa trifaria*.

At 5m, the reds *Thamnoclonium* and *Pessionella* common, indispersed with other reds and cup sponges.  
 At 4m, the reds *Thamnoclonium* and *Pessionella* common, with sparse covering of the browns *Carpoglossum* and *Ecklonia*. The green algae *Codium pomoides* also relatively common.  
 At 3m, *Carpoglossum* and *Ecklonia* common, and some *Phyllospora* present. Reds present, including encrusting corallines.

At 2m, *Macrocystis pyrifera*, *Phyllospora*, *Carpoglossum*, and *Ecklonia* present.

At 1m, *Macrocystis pyrifera*, *Xiphophora gladiata*, *Carpoglossum*, and *Acrocarpia* present.

Between 0 and 0.5m, *Durvillaea potatorum* was the major species present.

Fish: *Notolabrus fucicola* was moderately common. No other species sighted.

Invertebrates: *Halotis rubra* common, particularly at 3m. Some *Heliocidaris erythrogramma* present.

#### Site 16: Ashley Point

Grid Ref: 55G0415281 5206125

Offshore extent of reef: varies, to 100m

Maximum depth: 6.5m

Reef structure: Moderate, some boulderfield

Algae present:

Below 5m, cover by *Thamnoclonium* and *Peyssonelia* mostly, some *Melanthalia* and other reds present.

Browns enter at 5m, and between 3-5m most cover is *Ecklonia*, *Carpoglossum*, and some *Lessonia*.

At 2m, *Durvillaea*, *Perithalia* and *Carpoglossum*, are common.

0-2m, *Durvillaea*.

Fish: *Notolabrus fucicola* common, some *N. tetricus*, and *Aplodactylus arcidens*.

Invertebrates: *Jasus* common in boulderfields, *Halotis* common in patches.

#### Site 17: Northern shore where coast meets Kathleen Is at Mavourneen Rocks

Grid Ref: 55G041615 520490

Offshore extent of reef: ?m

Maximum depth: 5m

Reef structure: Flat.

Algae present:

0-3m, *Phyllospora*, *Xiphophora*, *Ecklonia*, and reds.

At 5m, *Ecklonia*, *Carpoglossum*, and reds, including *Melanthalia*.

Fish: *Dinolestes* present.

Invertebrates: -.

#### Site 18: Inside Kathleen Is

Grid Ref: 55G0416093 5204435

Offshore extent of reef: 8-20m (varies)

Maximum depth: 10m

Reef structure: Low.

Algae present:

9-8m, *Thamnoclonium*, and occasional other reds, and *Caulerpa trifaria*.

7-6m, Mostly encrusting corallines, some sparse *Carpoglossum*.

5-3.5m, mostly *Carpoglossum*, filamentous corallines and *Cystophora platylobium*.

0-3.5m, mostly *Durvillaea*.

Fish: *N. fucicola* moderately common, some *N. tetricus*.



Invertebrates: *Haliotis* moderately common, no others.

Site 19: Pt opposite Kathleen Is, at northern end of Toogelow Beach  
Grid Ref: 55G0416470 5204613

Offshore extent of reef: 30m

Maximum depth: 10m

Reef structure: Moderate with some cave and crevice development at middle depths.

Algae present:

5-10m, *Thamnoclonium*, reds, and sponges.

2.5-5m, *Thamnoclonium*, other reds (*Gelidium* sp?).

0-2.5m, *Durvillaea*.

Fish: *N. tetricus* present.

Invertebrates: -.

Site 20: Outer Kathleen Is  
Grid Ref: 55G1580 520440

Offshore extent of reef: 70m

Maximum depth: 18m

Reef structure: Moderate to high degree of structure, some large boulders with caves.

Algae present:

No algae below 14m, some turfing reds to 14m. *Thamnoclonium* entering at 10m. Large reds above 7m, mixed with encrusting corallines. No browns other than *Durvillaea*. *Durvillaea* distribution restricted to above 2m, mixed with some reds.

Fish: On deeper reef (10-18m), *Cheilodactylus spectabilis*, *Pseudolabrus psittaculus*, and *Notolabrus tetricus* present. Above 10m, *Notolabrus fucicola* common, some *Scorpius aequipinnis* present.

Invertebrates: *Haliotis rubra* abundant in gutters, particularly below 10m, moderate numbers of *Jasus* observed.

Site 21: Point to south of Toogelow Beach  
Grid Ref: 55G0416923 5203583

Offshore extent of reef: 100m

Maximum depth: 9m

Reef structure: Moderate, but with few crevices etc.

Algae present:

At 9m, invertebrates, including sea whips, and sea fans.

At 5-9m, *Thamnoclonium* becoming sparse, with fine reds and invertebrates increasing with depth.

3-5m, *Carpoglossum* and *Ecklonia*, with mixed reds (mostly *Melanthalia* and *Phacelocarpus*).

2-3m, mostly *Xiphophora*, and *Lessonia*, with reds (mainly *Gelidium* sp.).

0-2.5m, *Durvillaea*.

Fish: Few *N. fucicola*.

Invertebrates: Mostly *Pentagonaster*, with occasional *Jasus*.

Site 22: Milner Head North  
Grid Ref: 55G0417430 5202750

Offshore extent of reef: 25m

Maximum depth: 6m

Reef structure: Moderate but few caves, crevices.

Algae present:

6-5m, mainly invertebrates and *Thamnoclonium*.

At 5m, *Carpoglossum* and *Ecklonia* entering, with *Caulerpa brownii* and *C. geminata*, and *Peyssonelia* and corralines.

At 4m, *Carpoglossum*, some *Xiphophora*, *Durvillaea*, *Cystophora platylobium* and corralines.

At 0-2m, *Durvillaea*, with some bryozoans between 2-3m.

Fish: Mostly *N. fucicola* with occasional *N. tetricus*, *Latridopsis* and *Latris lineata*.

Invertebrates: Very few *Haliotis* or *Jasus*.

Site 23: Inner Breaksea

Grid Ref: 55G0416466 5202423

Offshore extent of reef: varies from 6-20m

Maximum depth: 7m

Reef structure: Moderate, but with few caves.

Algae present:

5-7m, mostly invertebrates, with conspicuous sea fans.

At 5m, *Carpoglossum*, *Ecklonia*, and the red *Peyssonelia*.

At 4m, *Carpoglossum*, *Ecklonia* and *Xiphophora*.

At 3m, *Carpoglossum*, *Ecklonia*, *Xiphophora*, and the lower margin of *Durvillaea*.

0-2m, *Durvillaea*.

Fish: *Notolabrus fucicola* common. Some *Latridopsis* and *Aplodactylus*.

Invertebrates: Low to moderate numbers of *Haliotis* and *Jasus*.

Site 24: Turnbull Head

Grid Ref: 55G0417302 5201482

Offshore extent of reef: 80-100m

Maximum depth: 8m

Reef structure: Low to moderate structure.

Algae present:

At 8m, reds, including *Peyssonelia*, *Melanthalia*, *Thamnoclonium* and encrusting corralines.

At 6m, first browns entering including *Ecklonia* and *Carpoglossum*. Reds including *Melanthalia*, *Peyssonelia*, and *Thamnoclonium*.

At 5m, 20% cover of *Ecklonia* and *Carpoglossum*, 10% cover of reds, remainder covered by corralines.

At 4m, 40% cover of *Ecklonia* and *Carpoglossum*, and 10% reds.

At 3m, cover of *Lessonia*, *Durvillaea*, and *Carpoglossum*.

At 0-2m, *Durvillaea* and some reds.

Fish: Some *N. fucicola*.

Invertebrates: Very few *Haliotis* or *Jasus*.

Site 25: Shanks Islands (eastern shore)

Grid Ref: 55G0415892 5200012

Offshore extent of reef: 30m

Maximum depth: 8m

Reef structure: Moderate, but few caves or crevices

Algae present:

At 8m, low flat reef with gravel. Some *Peyssonelia*, crustose corralines, fine reds and *Codium pomoides* present.

At 7m mostly bare rock with moderate to high abalone cover.

At 6m the edge of the browns. *Ecklonia*, *Carpoglossum*, reds and *Caulerpa brownii* present.

At 5m, mostly *Ecklonia* and *Carpoglossum*, with mixed reds.

At 4m, edge of *Durvillaea*, mostly *Ecklonia* and reds.

0-3m, *Durvillaea*.

Fish: *N. fucicola* common, no others sighted.

Invertebrates: *Haliotis* moderate to high abundance, particularly at 7m. Some *Pentagonaster* on deeper parts

Site 26: Southwestern shore, Lourah Is, Hannant Inlet

Grid Ref: 55G0417421 5199275

Offshore extent of reef: 15-20m

Maximum depth: 5m

Reef structure: Moderate with some cave and crevice development.

Algae present:

2.5-5m, *Thamnoclonium* and invertebrates, with sparse *Carpoglossum*.

1-2.5m, *Xiphophora*, *Carpoglossum*, and *Ecklonia*, with sparse *Durvillaea*.

0-1m, mostly *Durvillaea*.

Fish: *Notolabrus fucicola* moderately common.

Invertebrates: *Jasus* common in patches of boulders, *Haliotis* moderately common.

Site 27: Hannant Point

Grid Ref: 55G0416370 5198893

Offshore extent of reef: 70m

Maximum depth: 13m

Reef structure: flat to moderate with few caves.

Algae present:

At 10-13m, sponges and sparse reds, including *Thamnoclonium*.

At 8m, mostly reds, *Thamnoclonium*, *Peyssonelia*, and encrusting corralines. Some *C. trifaria*.

At 6.5m, the first browns, composed of sparse *Carpoglossum* and *Ecklonia*.

At 5m, sparse *Ecklonia* and *Carpoglossum*.

0-?m, *Durvillaea*.

Fish: A few *N. fucicola*.

Invertebrates: None sighted.

Site 28: Spain Bay (inshore, western side)

Grid Ref: 55G0415904 5197941

Offshore extent of reef: 50m

Maximum depth: 4m

Reef structure: Moderate but few caves, crevices.

Algae present:

At 4m, Mostly *Ecklonia* and *Carpoglossum*, with *Caulerpa brownii*, *C. longifolia*, *C. simplisiuscula*, and *C. trifaria*.

At 3m, *Carpoglossum*, *Ecklonia*, *Xiphophora*, and some *Durvillaea*, *Macrocystis* and *Phyllospora*.

At 2m, *Phyllospora*, *Ecklonia*, and *Carpoglossum*. Some *Macrocystis* and *Durvillaea*. Patches of *Macrocystis* (dense) in 2-3m.

At 1m, mixed *Durvillaea*, *Phyllospora*, and *Xiphophora* with some *Lessonia*.

Fish: Mostly *Notolabrus fucicola* with some *N. tetricus* and *Latridopsis*.

Invertebrates: None observed.

Site 29: South Spain Bay (eastern shore of Knapp Point).

Grid Ref: 55G0415427 5198458

Offshore extent of reef: 100m (patch reefs extend further offshore)

Maximum depth: 9m

Reef structure: Moderate, but few caves, crevices.

Algae present:

Below 7.5m various reds and coralline algae.

At 7.5m, edge of browns. Sparse *Ecklonia* and *Carpoglossum*. Mostly reds, especially *Peyssonelia* and *Thamnoclonium*.

At 6m *Ecklonia* and *Carpoglossum* (20%), with mixed reds (50%), and *Codium pomoides*.

At 4m Mostly *Xiphophora*, with some *Ecklonia*, *Carpoglossum*, and *Durvillaea*, with crustose and filamentous coralline reds.

At 3m *Durvillaea* and *Xiphophora*, with *Lessonia*, *Cystophora platylobium*, and crustose corallines.

0-2m *Durvillaea*.

Fish: Mostly *Notolabrus fucicola*, with occasional *N. tetricus*, and *Aplodactylus*.

Invertebrates: Occasional *Haliotis*.